Fact Sheet:

September 1997

(FL 52)

METAL ARC-SPRAYING FOR ELECTROMAGNETIC SHIELDING OF STRUCTURES

The Problem

Metal arc-spraying has a history of about 40 years with applications ranging from coatings for corrosion control, built-up bearing surfaces, and decorative coatings. While arc-spraying was used primarily for metal coatings on metal substrates, it will also adhere well to a wide variety of other substrate materials. The challenge is to determine the most efficient and effective ways of applying shielding to a variety of structures to protect them from an electromagnetic pulse and its effects.

The Technology

With arc-spraying, the metal to be sprayed is heated to its liquid molten state by an electric arc. Then an air blast breaks down this molten metal into fine droplets that cool and solidify when they strike the surface being sprayed. The bonding of the sprayed metal is primarily a mechanical bond with hardened metal droplets macroscopically meshing with the sprayed surface irregularities.

Recent industrial uses of metal arc-spraying technology include spraying the interior of electrical equipment cases to recover some of the inherent electromagnetic shielding lost when changing from metal to plastic.

For an arc-sprayed shielded room to perform satisfactorily, it needs a stable, crack-free substrate; a bond agent for some, if not most, substrate materials; and a uniform, complete metal coating of the surface. Studies to date have applied various metals to common construction materials used for walls, including: 1) an experimental zinc-on-drywall room, 2) a zinc-on-cinder-block-sprayed laboratory room for processing sensitive data, 3) a North Atlantic Treaty Organization

(NATO) classroom constructed with copper-arc-sprayed fiberglass panels, 4) a room with copper-on-fiberglass cloth glued to poured concrete walls and 5) a room using zinc sprayed onto fiberglass panels. Commercial contractors did the arc-spraying on all but the first room. The U.S. Army Construction Engineering Research Laboratories (CERL) also knows of a few rooms arc-sprayed under unrelated programs.

Benefits/Savings

Studies at CERL indicate that zinc and copper are useful materials for metal arc-spraying based on cost, workability, and performance. CERL's research indicates that a uniform coat of zinc 12 to 15 mils thick will satisfactorily provide an attenuation of 40-80 db at frequencies of 200 kHz and up. A room assembled from zinc-sprayed fiberglass panels was shown to cost about 60 percent of the cost of conventional bolt-together shielded rooms.

Status

Thermal spraying of molten metals is a well-established technology having many applications in addition to electromagnetic shielding. Numerous contractors and American and foreign manufacturers of arc-spray equipment have the necessary skills and equipment to arc-spray on a production basis. More than 30 arc-sprayed rooms have been constructed in Europe for communications security uses. CERL has constructed five arc-sprayed rooms.

In one constructed room, the metal was sprayed onto fiberglass cloth, then the sprayed composite attached to the supporting wall. The fiberglass substrate provides a base for the sprayed metal to prevent its cracking if the supporting wall cracks. Research efforts at CERL include using electromagnetic propulsion instead of compressed air for propelling molten metal droplets in the spray process. Future studies will experiment with applying fiberglass cloth to walls or panels before spraying. This effort will also include developing an adhesive for attaching the fiberglass cloth to the wall. The adhesive will allow the completed composite-sprayed shield to move when wall panel materials crack or shift.

Point of Contact

CERL POC is Paul Nielsen, COMM 217-373-7243; toll-free 800-USA-CERL; FAX 217-373-6732; e-mail p-neilsen@cecer.army.mil; or CERL, ATTN: CECER-FL-E, P.O. Box 9005, Champaign, IL 61826-9005.

Visit the CERL homepage at http://www.cecer.army.mil